4C 12 Bit Watermark Specification

October 29, 1999

(Sole Property of 4C Entity, LLC)

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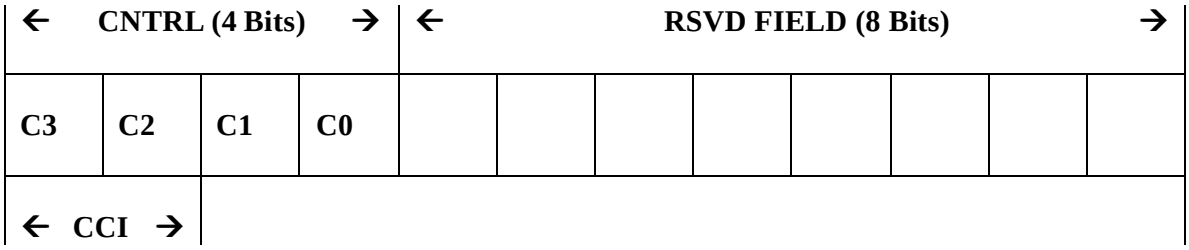
1.0 Purpose: This specification (4C 12 Bit Watermark Specification) covers the format configuration, timing, and other details including basic detector function of the 4C 12 Bit Watermark, but not the embedding and detecting technology itself. The 4C 12 Bit Watermark conveys Copy Control Information (CCI) and other important data in a specific formatted configuration which remain in the audio stream even after various processing, and are detectable when encryption protection is not present. The required responses of compliant equipment to data conveyed by the 4C 12 Bit Watermark are defined in separate documents and are not discussed herein. Additional requirements regarding embedding of CCI bits (e.g. limitation on use of the "No More Copies" state) are contained in separate documents and are not discussed herein.

2.0 Format Configuration: The following bit definitions, usage, and ordered arrangement shall apply in all circumstances, including embedding and detecting functions:

Figure 1: 4C 12 Bit Watermark Format Configuration



2.1 4C Data Payload (Mandatory Data): The following 12 data bits of CNTRL (4 bits) and RSVD FIELD (8 bits) as defined below and in the configuration described in Figure 1 comprise the 4C Data Payload. All bits of the 4C Data Payload shall be mandatory, and shall always be embedded anytime the 4C 12 Bit Watermark is used (note, embedding of the watermark itself in original content is optional). To maximize robustness it is recommended that the 4C 12 Bit Watermark be embedded in all audio channels (except for the low frequency effects channel in the case of multichannel).

CNTRL: 4 bits designated in the following manner
C3, C2: CCI bits (copy permission status)
- "00b": copying is permitted without restriction -- "Copy Freely"
- "10b": copy one generation is permitted -- "Copy One Generation" (for equipment compliant with the 4C Specification for DVD-Audio this implies "Copy One Generation" at equivalent to CD quality, or less, is permitted)
- "11b": no more copies are permitted -- "No More Copies"
- "01b": reserved for future use and shall not be embedded until specifically permitted by a future version of this document

Note-1: The use of the "11b", "No More Copies", state in packaged media is limited by requirements of other documents including the licensing agreements

Note-2: it is required that "10b" state be changed to "11b" state under certain circumstances as defined in other documents, such as the 4C Specification for copy protection of DVD Audio products.

C1: SDMI Trigger Bit (SDMI "upgrade to Phase 2 trigger")
"0b": trigger is not present
"1b": trigger is present

Note: refer to SDMI Portable Device Specification, Part I, Version 1.0 for additional information on the proper use of this bit.

C0: Reserved bit
C0 is reserved for future use
C0 shall be set to "0b" until further notice

RSVD FIELD: 8 bits reserved for future use
All bits of the RSVD FIELD shall be set to "0b" until further notice
Future use includes "Usage ID" and other functions

2.2 Optional Data: A 60 bit field for content identification (such as the International Sound Recording Code (ISRC)) or other data may be embedded pursuant to a separate licensing agreement and specification (see Table 1 for some reference data). Other watermarking applications using technology from ARIS Solana Corp. and/or other provider are not affected by this specification or related licenses, except if optional data of any kind are used, such data shall be embedded only in a manner which does not interfere with the proper operation of the 4C 12 Bit Watermark and detector.

3.0 Detection Time Window and Criteria: The 4C 12 Bit Watermark shall be embedded per Section 2.0 above such that it is possible to detect all bits of the 4C Data Payload (CNTRL and RSVD FIELD) at least once every 15 second interval of the content in a manner consistent with the detection criteria in Table 1 and Table 2 and the ARIS Specification. For reference, the optional ISRC field (if any) shall be embedded per the above format such that it is possible to detect all 60 bits of ISRC at least once every 30 second interval of the content, in a way that does not interfere with achieving the detection performance of the CNTRL and RSVD bits (a professional detector may be used for purposes of ISRC).

Table 1: 4C 12 Bit Watermark Detection Window and False Positive Rate

Type	**Size**	**Detection Time Window**	**False Positive Rate**
CNTRL	4 bits	15 seconds	Less than 10^{-12}
RSVD FIELD	8 bits	15 seconds	Not applicable
ISRC *	60 bits	30 seconds	Not applicable

* Provided for illustrative purposes only.

Table 2: 4C 12 bit Watermark Detection Criteria

True Embedded Status of CCI (C3, C2)	Watermark Not Detected or Detected Incorrectly	Detected as "Copy One Generation"	Detected as "No More Copies"
"Copy One Generation" ("10b")	Less than 50%	Greater than or equal to 50%	Less than 10^{-12}
"No More Copies" ("11b")	Less than 50%		Greater than or equal to 50%

4.0 Detector Function: Detection shall be performed either: (a) for each 15 second detection period on a pseudo-randomly selected channel chosen out of the total available (not including the low frequency effects channel in the case of multichannel); or (b) in such manner as might be approved in the future. At the conclusion of each 15 second detection period (or sooner), the detector shall report the status of all CNTRL and RSVD FIELD bits.